

CHANGE NOTICE

Date Prepared: 08/24/01

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| <p>THIS NOTICE INFORMS RECIPIENTS THAT THE DOCUMENT IDENTIFIED BY THE NUMBER (AND REVISION LETTER) SHOWN IN BLOCK 4 HAS BEEN CHANGED. THE PAGES CHANGED BY THIS CDCN BEING THOSE FURNISHED HEREWITH AND CARRYING THE SAME DATE AS THIS CDCN. THE PAGES OF THE PAGE NUMBERS AND DATES LISTED BELOW IN THE SUMMARY OF CHANGED PAGES COMBINED WITH NON-LISTED PAGES OF THE ORIGINAL ISSUE OF THE REVISION SHOWN IN BLOCK 4 CONSTITUTE THE CURRENT VERSION OF THIS DOCUMENT.</p> | | | | | | | | |
| 13. CDCN No. | | 14. Pages Changed (Indicate Deletions) | | | | S* | A* | 15. Date |
| 012 | | Revision and History page Page xiv Page 2-1 Pages 3-5, 3-7, 3-11, and 3-13 Page 4-4 Page A-1. 012 Page 3-11a. | | | | X | | 8/24/01 |
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| 16. Technical Concurrence (Contracting Agency) | | | | | | Date | | |

* "S" indicates supersedes earlier page. "A" indicates added page.

REVISION AND HISTORY PAGE

| REV. | DESCRIPTION | PUB. DATE |
|------|---|--------------|
| | BASELINE ISSE (REFERENCE SSCBD BB003053B EFF. 07-30-91) | 06-91 |
| | CHANGE 1 (REFERENCE SSCBD BB003457 EFF. 03-04-93) | 03-93 |
| | CHANGE 2 (REFERENCE SSCBD BJ003053C EFF. 03-08-93) | 04-93 |
| A | Revision A (Reference SSCBD 000002 dated 2-7-94) | 04-18-94 |
| B | Revision B (Reference SSCBD 000008R1 dated 06-03-94) | 09-30-94 |
| | The following DCNs have been cancelled. The content of the SSCNs authorizing release of the DCNs has been incorporated into Revision C. | |
| | DCN 001 (SSCN 000480) (Administrative Cancellation) | |
| | DCN 003 (SSCN 000913) (Administrative Cancellation) | |
| | DCN 002 (SSCN 000548) (Administrative Cancellation) | |
| | DCN 004 (SSCN 001356) (Administrative Cancellation) | |
| | DCN 005 (SSCN 000151) (Administrative Cancellation) | |
| | DCN 006 (SSCN 000256) (Administrative Cancellation) | |
| | DCN 007 (SSCN 000258) (Administrative Cancellation) | |
| | DCN 008 (SSCN 000549) (Administrative Cancellation) | |
| C | Revision C incorporates SSCDs 000151, 000256, 000258, 000480, 000548, 000549, 000913, 001356, and 001285. | 04-16-01 |
| | DCN 012 incorporates SSCN 001285 | 09-20-01 |

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2.0 APPLICABLE DOCUMENTS

The following documents of the exact date and issue in SSP 50257 form a part of this document to the extent specified herein. Inclusion of applicable documents herein does not in any way supersede the order of precedence specified in 1.6.

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| DOCUMENT NO. | TITLE |
|----------------------------------|---|
| SSP 41000 References | System Specification for the Space Station Paragraphs 1.6 and 3.1.5.1 |
| SSP 30233 References | Space Station Requirements for Materials and Processes Paragraph 3.6.1 |
| SSP 30558 References | Fracture Control Requirements for Space Station Paragraphs 3.1.3, 3.1.6, 3.1.9, 4.1.4, and Appendix B |
| SSP 30560 References | Glass, Window, and Ceramic Structural Design and Verification Requirements Paragraph 3.1.7, and Table 3.3.1–1 |
| D684–10019–01 References | Space Station Structural Loads Control Plan Paragraph 3.2, 3.2.2, 3.2.3, 3.2.4.1, 3.2.4.2, and 4.2 |
| MIL–HDBK–5 References | Metallic Materials and Elements for Aerospace Vehicle Structures Paragraph 3.6.2, Appendix B |
| MIL–HDBK–17 References | Plastics for Aerospace Vehicles Paragraph 3.6.2 |
| SSP 50005 References | International Space Station Flight Crew Integration Standards (NASA–STD–3000/T) Paragraph 3.1.5.2 |
| NSTS–21000–IDD–ISS References | Space Shuttle System Payload Accommodations Paragraph 3.2.1 |
| NSTS 08307 References | Criteria for Preloaded Bolts Paragraph 3.5.5 |
| NSTS 14046 References | Payload Verification Requirements Paragraphs 4.1.2.1.1 and 4.1.3.1 |
| 20M02540 References | Assessment of Flexible Lines for Flow Induced Vibration Paragraph 3.1.9.5 |
| NSTS 08123 References | Certification of Flex Hose and Bellows for Flow Induced Vibration Paragraph 3.1.9.5 |

On-orbit structural design loads shall be defined to a 3 sigma level for limit load during the Program life for time-consistent loads. When time consistency is unknown, a 3 sigma equivalent load probability for each independent event on each type of load shall be used and load combinations shall be root sum square of the 3 sigma peak independent event consistent loads; or, a monte carlo analysis producing a 3 sigma load combination may be used. For major independent system failures, 2 sigma or equivalent loads shall be used. Random limit loads shall be defined as 3 sigma. A 3 sigma level shall be defined as a 99.73 percentile level for loads which are characterized by a 1-sided Gaussian or non-Gaussian distribution. A 2 sigma level shall be defined as a 95.45 percentile level for loads which are characterized by a 2-sided Gaussian distribution and a 97.72 percentile for loads which are characterized by a 1-sided Gaussian or non-Gaussian distribution. Launch transient and random vibration loads shall be derived in accordance with the Space Station Loads Control Plan, D684-10019-01.

3.2.1 SHUTTLE PAYLOAD CONFIGURATION DESIGN LOADS

For lift-off, ascent, on orbit, descent, and landing using Shuttle, Space Station structure shall be designed to maintain required functionality and positive margins when subjected to all static and dynamic loads and thermal environments as defined in NSTS 21000-IDD-ISS, Shuttle/Payload Interface Definition Document for International Space Station. Space Station structure shall be designed to maintain positive margins when subjected to emergency landing loads as defined in NSTS-21000-IDD-ISS.

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3.2.2 INTEGRATED ON-ORBIT LOADS

The coordination, generation, and dissemination responsibility for Space Station on-orbit, integrated element interface loads is defined in the Space Station Structural Loads Control Plan, D684-10019-01.

For integrated on-orbit flight, ISS Program elements shall be designed to maintain required functionality and positive margins when subjected to all static and dynamic loads and thermal environments. All integrated on-orbit configurations from first launch through assembly complete configuration shall be considered.

3.2.3 DETAILED DESIGN LOADS

Detailed design loads shall be derived for all life cycles of hardware in accordance with the Space Station Structural Loads Control Plan, D684-10019-01.

3.2.4 MATH MODELS

3.2.4.1 ON-ORBIT FLIGHT HARDWARE LOADS MATH MODELS

Structural math models of on-orbit element flight hardware consistent with each phase of the Program shall be forwarded to the Prime Contractor in accordance with the Space Station Structural Loads Control Plan, D684-10019-01.

TABLE 3.3.1–1 Factors of Safety for Test Verified Structure

| | Yield | Ultimate |
|---|-------------------------------|--------------------------|
| Proof Pressure ¹ | =1.50 X MDP | |
| Ultimate Pressure | =2.00 X MDP | |
| 3. Hydraulic and Pneumatic Systems | | |
| a. Lines and fittings less than 1.5 inches (38 mm) dia. (OD) | | |
| Proof Pressure ¹ | =1.50 X MDP | |
| Ultimate Pressure | =4.00 X MDP | |
| b. Lines and fittings, 1.5 inches (38 mm) dia. or greater | | |
| Proof Pressure ¹ | =1.50 X MDP | |
| Ultimate Pressure | =2.00 X MDP | |
| c. Reservoirs/Pressure Vessels | | |
| Proof Pressure ¹ | =1.50 X MDP | |
| Ultimate Pressure | =2.00 X MDP | |
| d. Actuating cylinders, valves, filters, switches, line-installed alignment bellows and heat pipes | | |
| Proof Pressure ¹ | =1.50 X MDP | |
| Ultimate Pressure | =2.50 X MDP | |
| e. Flex hoses, all diameters | | |
| Proof Pressure ^{1,3} | =2.00 X MDP | |
| Ultimate Pressure | =4.00 X MDP | |
| 4. Doors, Hatches and Habitable Modules | | |
| a. Internal pressure only | | |
| Proof Pressure ¹ | =1.50 X MDP | |
| Yield Pressure | =1.65 X MDP | |
| Ultimate Pressure | =2.00 X MDP | |
| b. Negative pressure differential | =1.40 X differential pressure | |
| c. Combined loading conditions (Ref. NSTS 14046, paragraph 5.1.1.5c) | | |
| 5. Combined pressure and mechanical loading ² | | |
| | Yield | Ultimate |
| Space Shuttle | 1.0(pressure+mechanical) | 1.4(pressure+mechanical) |
| On-Orbit | 1.1(pressure+mechanical) | 1.5(pressure+mechanical) |
| Notes: | | |
| 1. Proof factor determined from fracture mechanics service life analysis must be used if greater than minimum factor. | | |
| 2. See paragraph 3.5.1.1 when pressure loads have a relieving or stabilizing effect on structural capability. | | |
| 3. In a system with fluid lines and flex hoses, the individual flex hoses to be proof tested to 2.00 X MDP and the assembly level tested to 1.5 X MDP or proof factors as per note 1. | | |

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3.5.4.2 BEARING FACTOR

A bearing factor of 2.0 shall be used in conjunction with the yield and ultimate FS for the design of a joint subjected to shock or hammering action.

3.5.4.3 CASTING FACTOR

If metal castings are utilized as a fabrication process, an appropriate casting factor shall be developed by the design organization. The casting factor shall be applied in conjunction with the FS. Approval for the appropriate casting factor shall be obtained from NASA and/or International Partner. If a casting is a fitting, then the fitting factor shall be applied in conjunction with the casting factor and applied with the respective yield and ultimate FS.

3.5.5 PRELOADED JOINT CRITERIA

Bolt design in preloaded joints shall be in accordance with NSTS 08307, Criteria for Preloaded Bolts. Alternative methods to NSTS 08307 require prior NASA approval. A preloaded joint is a joint in which the preload is necessary to preserve linear structural behavior and to have adequate life due to cyclic loads, or to assure that no joint separation and resulting stiffness change occurs up to limit load, or to assure that no joint separation occurs at limit load which would affect pressure seals.

3.5.6 COMPOSITES/BONDED STRUCTURE DESIGN

Composite/bonded structure shall be designed to the factors of safety listed in Table 3.3.1–1, and to the life verification requirements of paragraph 4.1.3.4.

3.5.7 STRUCTURAL LIFE REQUIREMENTS

All structural components shall be evaluated for their capability to sustain static and cyclic load conditions which are part of the design environment. For those components whose design is subjected to a cyclic or repeated load condition, or a randomly varying load condition, a cyclic life analysis shall be performed.

Fracture analyses per the requirements of 3.1.6 shall be performed to demonstrate structural life for fracture critical structure. Fatigue or durability analyses shall be performed as necessary to demonstrate life for non-fracture critical structure. Structural life is defined as 4.0 times the service life loading environment for safe-life or fatigue analysis and 2.0 times the service life for durability analysis to account for material data scatter. The assumed flaw for durability analysis is a 0.005 inch corner crack or equivalent in the worst location and orientation. **DCN 012**

3.5.7.1 PROOF TEST FOR FLAW SCREENING

When proof tests are used for flaw screening, the proof test factor shall be the larger of the values determined by the fracture mechanics analysis derived proof test requirements to meet service life or those specified in Table 3.3.1–1.

3.5.7.2 FATIGUE

All flight hardware structure shall be designed to preclude failure resulting from cumulative damage due to cyclic loading and sustained stress during the design service life. Structural life shall be demonstrated by analysis and/or test based on a rationally derived cyclic loading spectrum that includes Shuttle transport to and from orbit, on-orbit, transportation, and testing loads.

3.6.2 STRUCTURAL MATERIAL ALLOWABLE PROPERTIES

Space Station material structural properties in the design environment shall be determined from MIL-HDBK-5, Metallic Materials and Elements for Aerospace Vehicle Structures; MIL-HDBK-17, Plastics for Aerospace Vehicles; or other sources which provide reliable and statistically valid data. Structural material property data obtained specifically for Space Station shall be generated by the procedures outlined in MIL-HDBK-5.

3.6.2.1 “A” ALLOWABLES

Material “A” or equivalent allowable values shall be used in all applications where failure of a single load path could result in a loss of structural integrity in primary structure. Equivalent material properties shall be approved by NASA and/or the International Partner.

3.6.2.2 “B” AND “S” ALLOWABLES

Material “B” or “S” or equivalent allowable values may be used in redundant structure in which the failure of a component would result in a safe redistribution of applied loads to other load-carrying structure. MIL-HDBK-5 material “S” allowables may be used for materials in lieu of “A” and “B” allowables where batch lot acceptance testing is a procurement requirement. Equivalent material properties shall be approved by NASA and/or International Partner.

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3.7 SECONDARY STRUCTURE ACCOMMODATION FOR HUMAN INTERFACE

3.7.1 INSPECTION, MAINTENANCE, AND REPAIR

Interior secondary structures, stand-offs, attachment hardware, utility runs, partitions, walls, and close-out structure of the Space Station shall be designed for accessibility to other hardware for inspection, maintenance, and repair.

3.7.2 INTERIOR CLOSE OUT

Close-out structure shall be used on the Space Station to prevent items from becoming lost in the low-gravity environment.

3.7.3 GROUND AND ON-ORBIT OPERATIONAL ACCESS DOORS

Secondary structures such as compartment doors and access panels which provide access shall be operational in both ground and Earth orbit environments.

3.8 NONSTANDARD FASTENERS

NASA and/or International Partner approval shall be obtained for the use of nonstandard or specially manufactured fasteners.

4.1.4 FUNCTIONAL CONFIGURATION AUDIT/PHYSICAL CONFIGURATION AUDIT

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The responsible design organizations shall provide stress analysis documentation of all structure to assure compliance with strength and deformation requirements. Stress analysis reports shall be submitted to NASA in support of the following four design reviews: Preliminary Design Review (PDR); Critical Design Review (CDR); Functional Configuration Audit/Physical Configuration Audit (FCA/PCA); and Flight Readiness Review (FRR), as delineated in the following paragraphs. These analyses shall be current with respect to loads and the design at the time of the review. Fatigue analyses shall be submitted with the stress analysis reports. Current stress analyses shall be available to support interim reviews. The stress analysis reports shall be prepared in accordance with standard aerospace industry practices for flight hardware.

Guidelines for stress analysis reports are documented in JSC 19652, Instructions for the Preparation of Stress Analysis Reports. If the results from other than closed form solutions, e.g., computer models, are presented in a stress analysis, both the logic and sufficient checks shall be present to assure that the data presented is a solution to the configuration and condition being analyzed.

4.1.4.1 STRESS ANALYSIS FOR PRELIMINARY DESIGN REVIEW

The PDR stress analysis shall be sufficiently detailed to assure the structural integrity of all major structure elements and the credibility of weight calculations.

4.1.4.2 STRESS ANALYSIS FOR CRITICAL DESIGN REVIEW

This analysis shall fully substantiate the structural integrity of each detailed part and provide the basis for stress signatures required on all drawings. Life requirements shall be addressed in this analysis.

4.1.4.3 FORMAL FCA/PCA STRESS REPORT

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A formal stress report shall be submitted to and approved by NASA and/or international partner prior to the FCA/PCA.

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4.1.4.4 STRESS ANALYSIS FOR FCA/PCA

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This analyses shall include changes or additions to the formal CDR stress analysis data package and shall fully substantiate the structural integrity of each detailed part, including structural verification tests, life verification, and detailed evaluation of the “as-built” hardware.

4.1.4.5 STRESS ANALYSIS FOR FLIGHT READINESS REVIEW

These data shall include only revisions to update the stress analysis reports for the flight design configuration with all significant changes from the FCA/PCA.

APPENDIX A ABBREVIATIONS AND ACRONYMS

| | | |
|---------|---|-----------|
| CDR | Critical Design Review | |
| EVA | Extravehicular Activity | |
| FCA/PCA | Functional Configuration Audit/Physical Configuration Audit | DCN 012 ■ |
| FRR | Flight Readiness Review | |
| FS | Factor of Safety | |
| HDBK | Handbook | |
| IVA | Intravehicular Activity | |
| ISS | International Space Station | |
| LBB | Leak Before Burst | |
| MIL | Military | |
| mm/od | Micro–Meteoroid / Orbital Debris | |
| MDP | Maximum Design Pressure | |
| MS | Margin of Safety | |
| NASA | National Aeronautics and Space Administration | |
| NSTS | National Space Transportation System | |
| ORU | Orbital Replacement Unit | |
| PDR | Preliminary Design Review | |
| psia | Pounds per square inch absolute | |
| REV | Revision | |
| S/N | Stress versus cycle life | |
| STD | Standard | |
| SSCBD | Space Station Change Board Directive | |
| SSCM | Space Station Change Memorandum | |
| SSP | Space Station Program | |